IN SENATE OF THE UNITED STATES.

July 31, 1848.

Submitted, and ordered to be printed.

Mr. Mason made the following

REPORT:

The Select Committee, to whom was referred the memorial of H. Tudor Brownell, on behalf of the "Hartford Argillo Manufacturing Company," have had the same under consideration, and respectfully report:

That the memorialist has, at their request, exhibited to them various specimens of the "argillo," in the form designed for some of the uses of which it is susceptible—that is to say, of slabs for ornamental tables; of pannels; of tiles for flooring, &c.; and of every variety of hue; and they have obtained a report from two gentlemen of science, (Messrs. W. R. Johnson and Z. C. Robbins,) who subjected it to chemical and other tests, with a view to ascertain its durability and general fitness for practical use.

The material itself is thus described by those gentlemen in their report:

"The specimens of argillo, which you have submitted for our inspection, all present the appearance of completely vitrified compounds of silica, with aluminous and alkaline earths and metallic oxides; the latter having the effect of communicating to the mixture various shades of color. Among these the darker tints predominate—olive green, blue, deep red, ochery yellow, brown, and black; but the livelier hues are by no means uncommon, orange, yellow, light sky blue, and even white, being seen in a few samples. Indeed the color is varied almost *ad libitum*, to suit the special purpose of the manufacturer."

In the truth and accuracy of this description the committee entirely concur.

They confidently recommend it for all uses to which marble is applied, either in ornamental work or otherwise in the interior of buildings, and to which it is superior, both in its variety of hue and coloring, and in brilliancy and lustre.

The committee annex to this report that of the scientific gentlemen who have been named, for more minute and accurate information relating to argillo; and while they feel at liberty to recommend its use as a substitute for marble in the public buildings, yet,

as the material is new, those who are entrusted with the immediate execution of such works should take proper precaution to ensure its careful manufacture, by the process of annealing, or otherwise, to impart the degree of durability which is necessary to its perfection.

The committee are informed that it can now be furnished by the manufacturers at rates cheaper than marble.

Report of an examination of some artificial materials used for pavements, and for other purposes, under the name of argillo, by Walter R. Johnson and Zenas C. Robbins, consulting engineers, Washington, D. C.

WASHINGTON, D. C., *June* 30, 1848.

GENTLEMEN: Agreeably to your request, we have examined the specimens of artificial paving materials, called by you argillo, which you state to be manufactured by companies having establishments for that purpose in Hartford, Connecticut, and in Albany, New York.

The specimens of argillo, which you have submitted for our inspection, all present the appearance of completely vitrified compounds of silica, with aluminous and alkaline earths and metallic oxides; the latter having the effect of communicating to the mixture various shades of color. Among these the darker tints predominate—olive green, blue, deep red, ochrey yellow, brown, and black; but the livelier hues are by no means uncommon, orange, yellow, light sky blue, and even white, being seen in a few samples. Indeed the color is varied almost *ad libitum*, to suit the special purpose of the manufacturer."

The specific gravity of one sample, which seemed to be of fair average quality, we found to be 2.667, while that of limestones and marbles varies from 2.40 to 2.86. Hence, it appears that the density of the argillo is fully equal to the average of those natural substances, and is rather above that of plate glass, which varies from 2.50 to 2.60.

The forms of articles produced from this vitrified material are exceedingly various, embracing tiles, tables, pannels for doors, handles for bells, and knobs for doors, drawers, and other furniture.

These articles receive a polish equal, at least, to that of the finest marble, and scarcely inferior to that of many gems. Indeed it has been occasionally, by way of experiment, employed to form substitutes for the latter in the production of jewels and cameos.

Its hardness is such as to resist several of the lower, and even certain of the higher, mineralogical tests; but a sharp quartzose sand, with water, cuts it with about the same facility as it cuts ordinary glass.

In regard to its toughness, we may remark that, by the different modes of manufacture, particularly by the greater or less length of time devoted to the annealing process, considerable differences may

be produced. A wonderful power to resist both slow and rapid percussion was manifested by some of the thoroughly annealed samples which came under our examination, as described in a subsequent part of this report.

For certain uses, to which the argillo might be applied, it appeared to us desirable to ascertain how far acid substances might affect its durability. Its vitreous character led us to expect that it would be much less affected by acids than marble. On this point, the experiments fully justified our expectations. Even the strong acids have very little effect at the moment of application.

Nitric acid, whether concentrated or diluted, produced scarcely any visible effect. After some hours, it was found to have dimmed the polish of its surface.

Strong sulphuric acid had a rather more decided effect; giving, after 24 hours, a white, dry coating, and producing a more effectual tarnish of the polished surface than had been derived from nitric acid.

The proper solvent of argillo is concentrated muriatic acid; which leaves, after a digestion of several days, a surface coating of nearly pure silica, not difficult of removal, and which falls off readily when the undissolved mass is dipped into pure water.

In point of security against atmospheric influences, we judge that the argillo stands nearly on a level with flint glass; preserving its polish and the beautiful variegation of its colors; while both marble and sandstones are more or less influenced by the action of air and moisture. Oil and grease are known to produce almost indellible stains on marble, and some other natural paving materials; but, from the artificial material now under consideration, their impression would be no more difficult of removal than from common glass.

Having presented our views respecting the other characters of this substance, we would next offer the results of some direct experiments instituted to test its powers of resistence to mechanical violence. When thoroughly annealed, it is with difficulty abraded by a file; still less is it affected by the rubbing of stones and gravel, or of the lighter soil liable to adhere to the feet of persons walking over it.

When laid as a pavement, in a suitable bed of cement, with its joints adequately secured, it could be endangered only by violent blows. Heavy bodies, if hard and inelastic, might, by falling on the surface, give so violent a percussion to a limited space on the tile, as to produce fracture before the natural elasticity of material could be brought into action to transmit the force to the whole surface of its base.

With a view to this property, and in order to prove how nearly its toughness, after three days of annealing, would approach that of marbles and sandstones of known character, we subjected to experiment an argillo tile, of hexagonal form, $3\frac{7}{8}$ inches on a side, and $1\frac{1}{8}$ inches thick, placed in a bed of sand well compacted, and confined in place by a curb of ledges, but little larger than the tile, the interstices being likewise filled with sand carefully shaken

down, the whole resting on a plank of two inches in thickness, over a solid foundation of brick work.

In each case the tiles were settled into place, before commencing the trials, by placing on the upper surface a piece of half-inch board, on the centre of which was let fall, from a height of $5\frac{1}{2}$ inches, a cylinder of cast iron $1\frac{1}{2}$ inches in diameter, 18 inches in length, and weighing exactly ten pounds.

With these arrangements, comparative trials were made on the following specimens of paving materials, viz:

Two of argillo.
One of Aquia sandstone.
One of Seneca sandstone.
One of American white marble.
One of American blue marble.
And one of Italian white marble.

The Aquia sandstone was of the kind used in the Treasury building, Patent Office, and other edifices in Washington.

The Seneca stone was a specimen of that employed at the Smithsonian Institution, now in progress of construction.

At the *first* experiment on each tile, the ten pound cast iron weight was allowed to fall endwise, from a height of six inches, directly upon the centre of the specimen. In no instance did this break the tile.

At the second trial, the weight was allowed to fall from double the first height, or through a space of one foot.

When the specimen was not broken by the second trial, a third fall was allowed to take place from the same height.

The fourth trial, from a height of two feet, in no case failed to break the tile.

The following table exhibits a synopsis of all the experiments, the fractures taking place, in every instance, in lines radiating from the central point of percussion:

No. of tile.	Material of tile.	No. of 6-inch falls.	No. of 12-inch falls.	No. of 24-inch falls.	Remarks.
1	American white marble	1	1	0	Broke into 4 pieces.
2	American blue marble.	1	1	0	Broke into 2 "
3	Italian white marble...	1	1	0	Broke into 4 "
4	Argillo, No. 1.....	1	1	0	Broke into 10 "
5	Argillo, No. 2.....	1	1	0	Broke into 10 "
6	Aquia sandstone.....	1	2	1	Broke into 4 "
7	Seneca sandstone.....	1	2	1	Broke into 4 "

It is proper to state that the Italian marble tile was one inch in thickness; that the other marbles, the two sandstones and the argillo No. 1, were made to correspond as nearly as practicable, the argillo being used as a standard, of which the thickness was one and one-eighth inch. The argillo No. 2 was about one-tenth of an inch less in thickness than No. 1.

Neither on the marbles nor the argillo tiles was any distinct impression or sign of a penetration of the surface left at the first impact or 6-inch fall.

The Aquia sandstone, on the contrary, was slightly impressed by the first blow, quite visibly so by the second and third, and at the fourth or two-feet fall, which finally broke the specimen, a very considerable disintegration took place about the central point where the blows had fallen.

The Seneca stone was but little penetrated by the first three blows, and gave, at the fourth, a clean fracture, nearly corresponding to those of the marbles.

It was remarked that the fractures of the Argillo tiles proceeded with great regularity, in radial lines, from the centre to the periphery of the specimens.

It was stated to us that the samples now tried had been annealed three days, and were withdrawn from the oven while yet too hot to be handled, but that your plan of manufacture contemplated a much more protracted annealing, which had, in fact, been applied to the door-knobs, &c., submitted to examination. A door-knob of argillo, to which a shank of iron was united by means of a stirrup of the same, cast in, as usual, when the knob was made, was selected for trial. This, we were informed, had been annealed fourteen days, and taken out quite cold. It had a high and beautiful polish.

After several trials on different hard substances had convinced us that no ordinary glass could endure the like violence, we made use of it three several times in driving eight-penny nails into flooring boards, quite up to their heads. As this produced no impression on the argillo, except a slight tarnishing of the polish at the striking points, it was next applied about ten or twelve times in rapid succession, with much force, to a brick hearth, and finally gave way, losing a fragment from one side, but the remaining portion not being loosened in the stirrup.

The knob on the opposite end of the same shank was next placed in the same bed in which the tiles had been tried, and was subjected, first, to a six-inch fall of the ten-pound weight, then to two twelve-inch, and finally to four twenty-four-inch falls, without producing any apparent tendency to yield.

In these trials, care was taken that the knob should lie with its centre accurately beneath the axis of the suspended weight, in order that no defect of action might result from the glancing off of the iron when it fell.

Having thus proved its power to withstand numerous heavy blows, we next withdrew the knob from the sand, and using it as a hammer, first broke with it, into numerous fragments, one of the four pieces into which the tile of American white marble had been sep-

arated by the falling weight, as above detailed. This required six or eight smart blows. It was next used on the *end* of one of the two pieces into which the tile of blue marble had been broken, and, at about the seventh or eighth stroke, given with increasing force, a fragment of the argillo was at length detached.

These trials demonstrate the great toughness of this material, when subjected to that careful and long-continued annealing which you apply to the articles furnished to commerce.

In conclusion, we may state that the above-detailed experiments appear to us to prove that, under ordinary usage, argillo pavements will, owing to their superior hardness, be subject to less deterioration than either sandstones or marbles; that, where heavy articles are thrown upon them, they will be nearly or quite on a par with marble, in point of power to resist fracture; and, though both of these materials are more brittle than sandstones, they are less liable to be penetrated and marred by either percussion or pressure.

In its power to resist chemical re-agents, the argillo stands unquestionably superior to marble, and also to many sandstones, especially such as contain sulphuret of iron. The latter would undergo decay where the argillo would remain altogether without deterioration.

WALTER R. JOHNSON,
ZENAS C. ROBBINS,
Consulting Engineers.

To. Messrs. John Paige Pepper and
H. Tudor Brownell, Esqs.